Canal Seepage Loss in the Lower Beaverhead River Basin

Ground Water Investigation Program

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Ground Water Investigation Program (GWIP)
Montana Bureau of Mines and Geology

- Specific groundwater research questions
- Local
- Sub-basin
- Very intensive, one to three year duration

Results

- A scientific basis for decision making and resource management
- Computer Model files passed on to other users
- A comprehensive set of hydrogeologic data available to the public

Today's Talk

Illustrate the importance of canal seepage in recharging groundwater which ultimately contributes to river base flow.

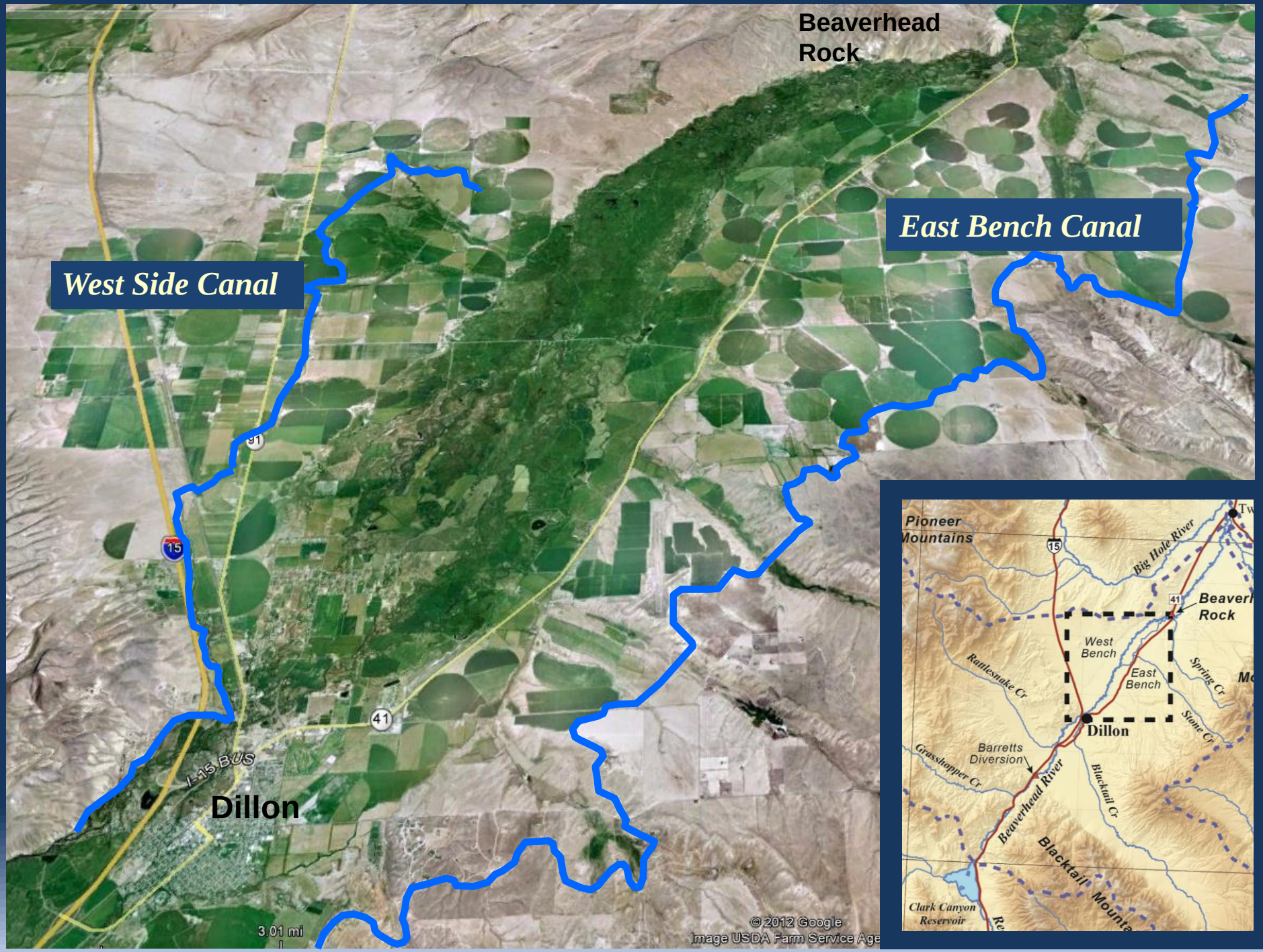
- Introduce the study area
- Mechanisms that result in groundwater recharge
- Groundwater hydrographs
- Seepage estimates on two canals
- Overall long-term influence of the East Bench Canal
- Monitoring results (seasonal) near both the East Bench and West Side Canals

Project Purpose

Is groundwater drawdown and stream depletion occurring due to high-capacity irrigation pumping from aquifers?

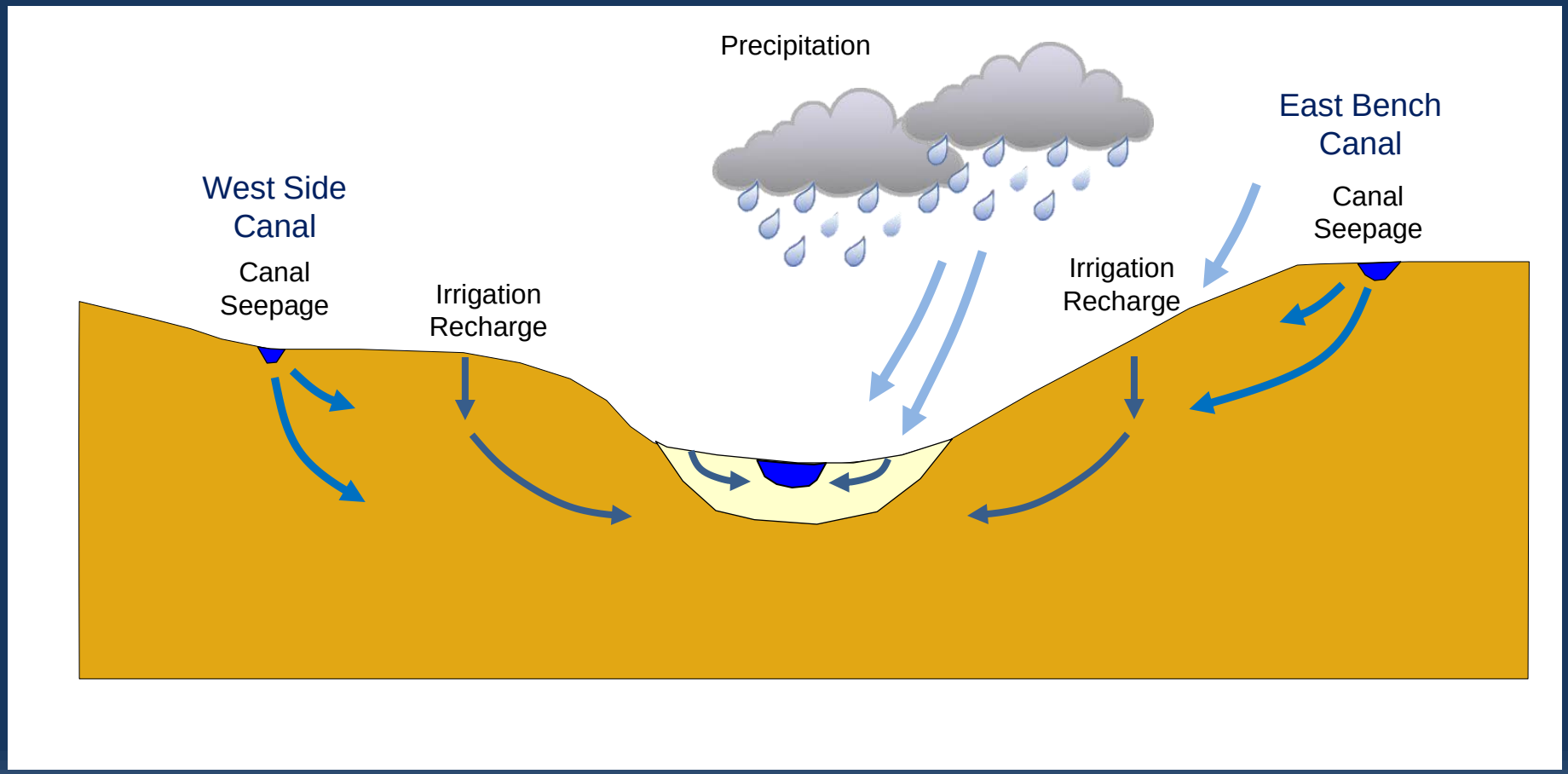
Main Project Objectives

- Groundwater movement and groundwater trends
- Water budget
- **Quantify groundwater recharge from canals** and irrigated fields
- Groundwater/surface-water interaction
- Evaluate potential stream depletion

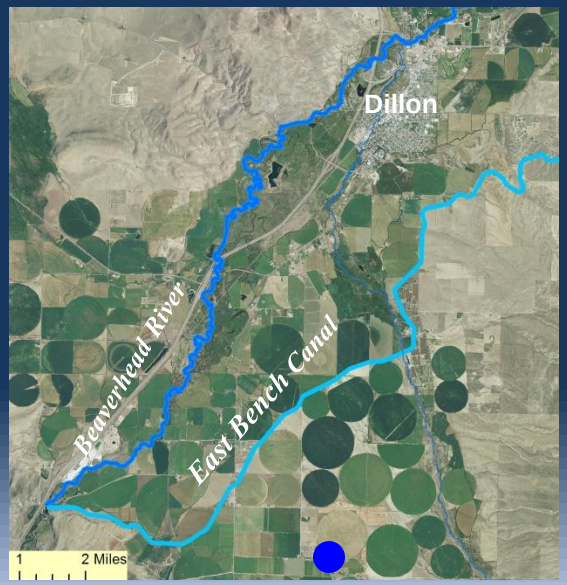

Beaverhead Rock
East Bench Canal
West Side Canal
91
15
41
I-15 BUS
Dillon
3.01 mi
© 2012 Google
Image USDA Farm Service Age
Pioneer Mountains
Big Hole River
Beaverhead Rock
West Bench
East Bench
Rattlesnake Cr
Spring Cr
Stone Cr
Dillon
Barretts Diversion
Grasshopper Cr
Beaverhead River
Blacktail Cr
Blacktail Mounta
Clark Canyon Reservoir

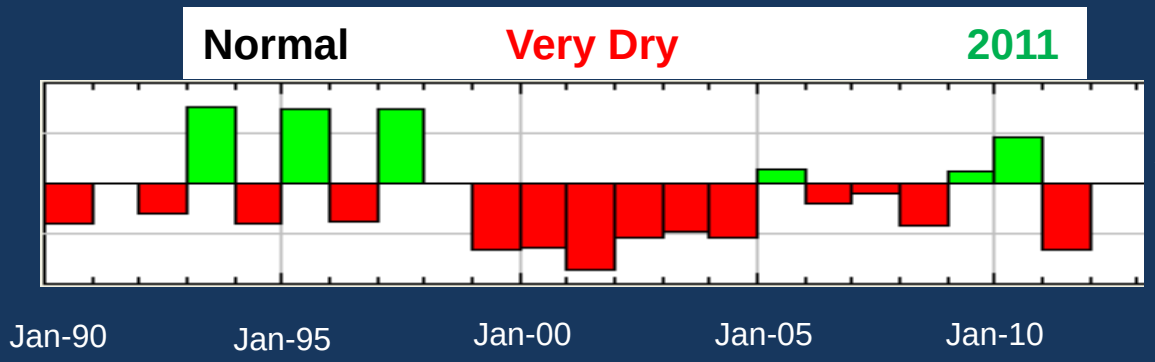
Groundwater Recharge

East Bench Canal

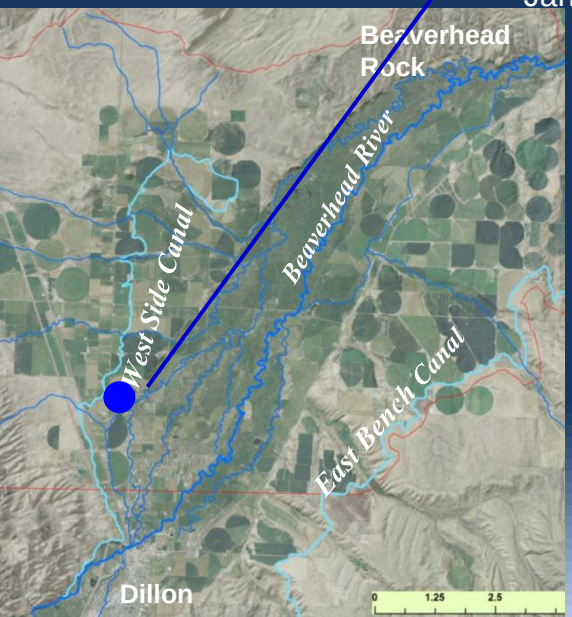


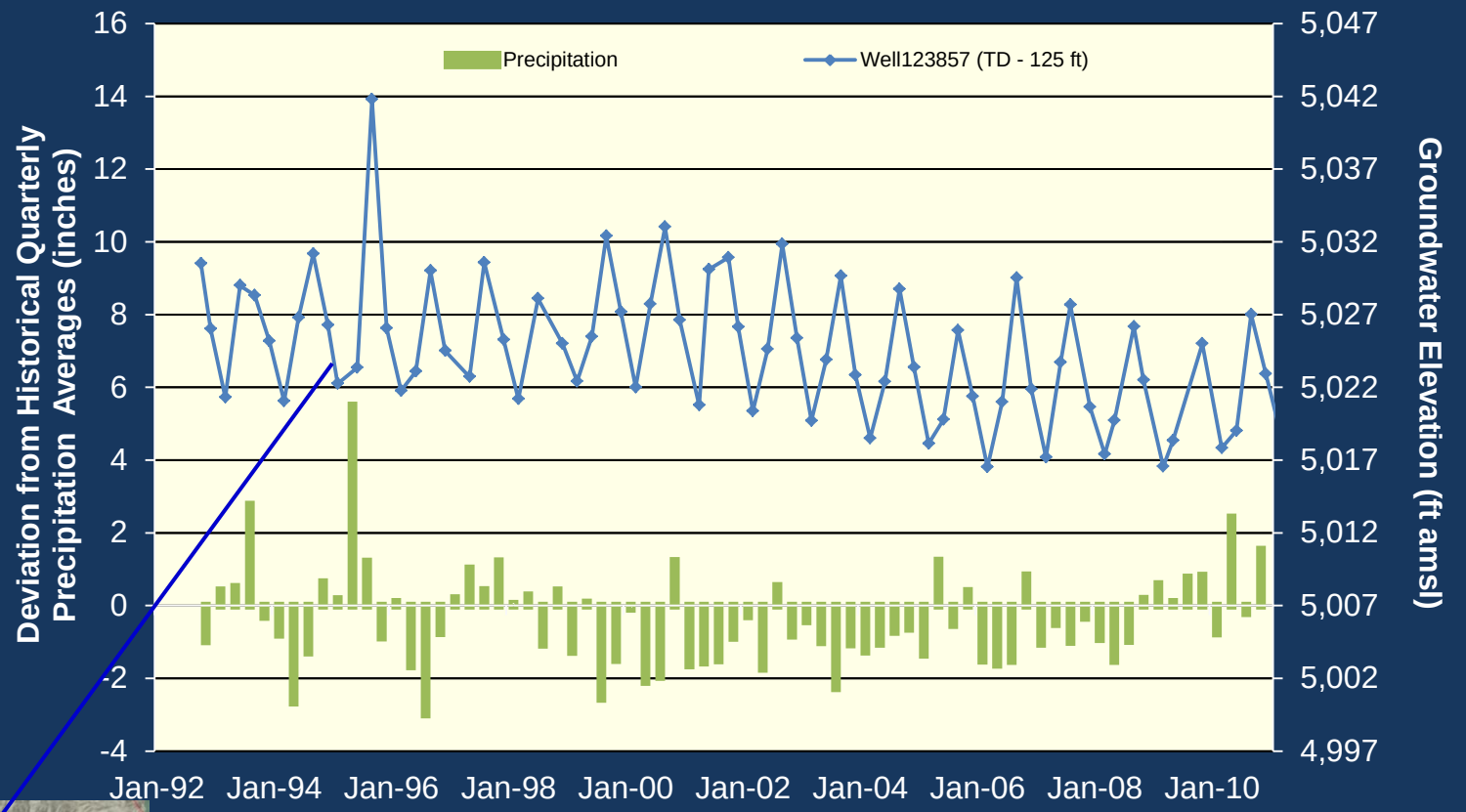
Precipitation Influence





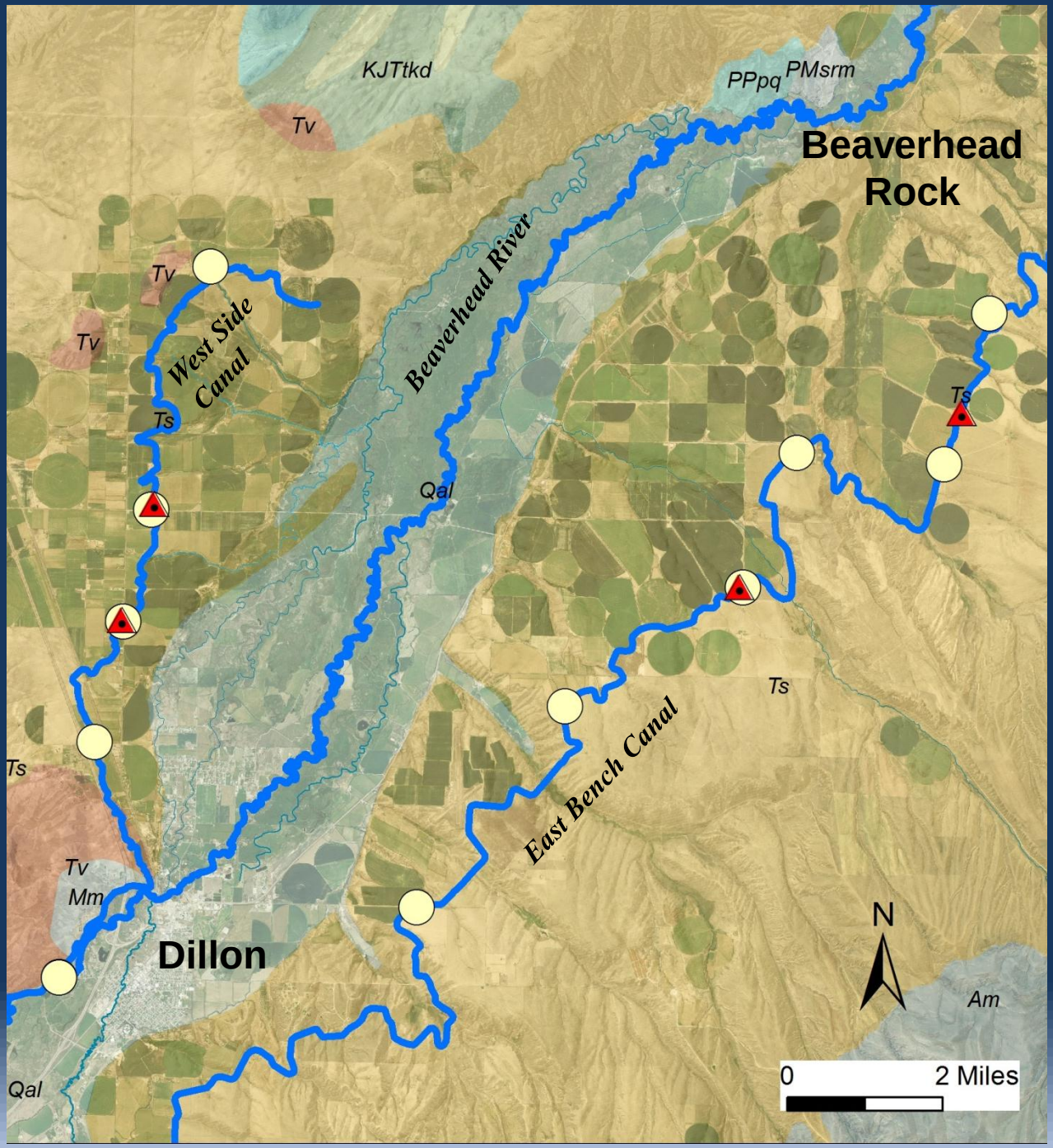
Departure from Annual Average Precipitation





Groundwater Trends

West Bench Irrigation/Canal Seepage Influence

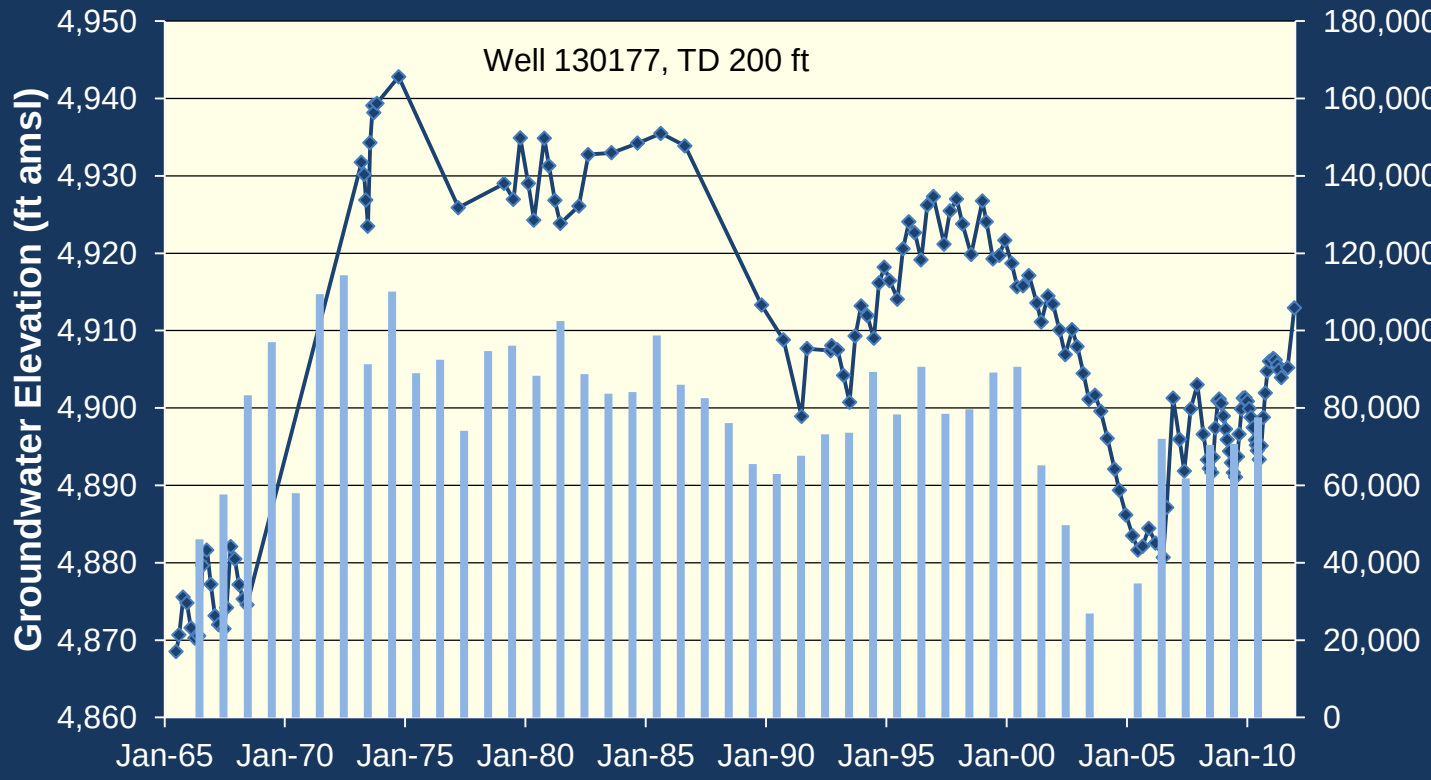


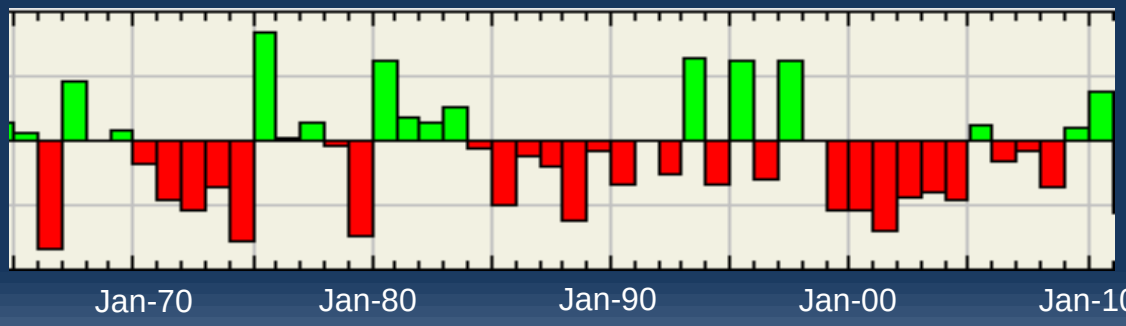
Canal Monitoring Locations

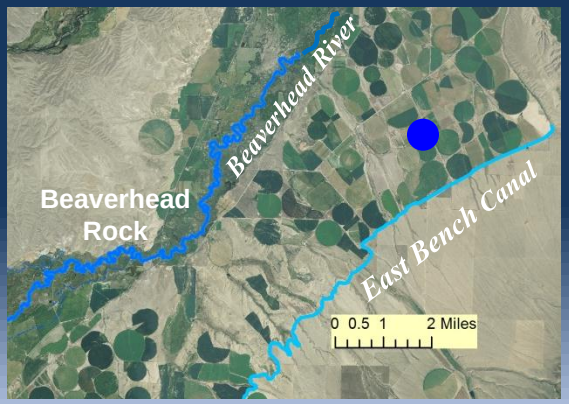
Average seepage loss

- West Side Canal
  1.2 cfs/mile
- East Bench Canal
  2.2 cfs/mile

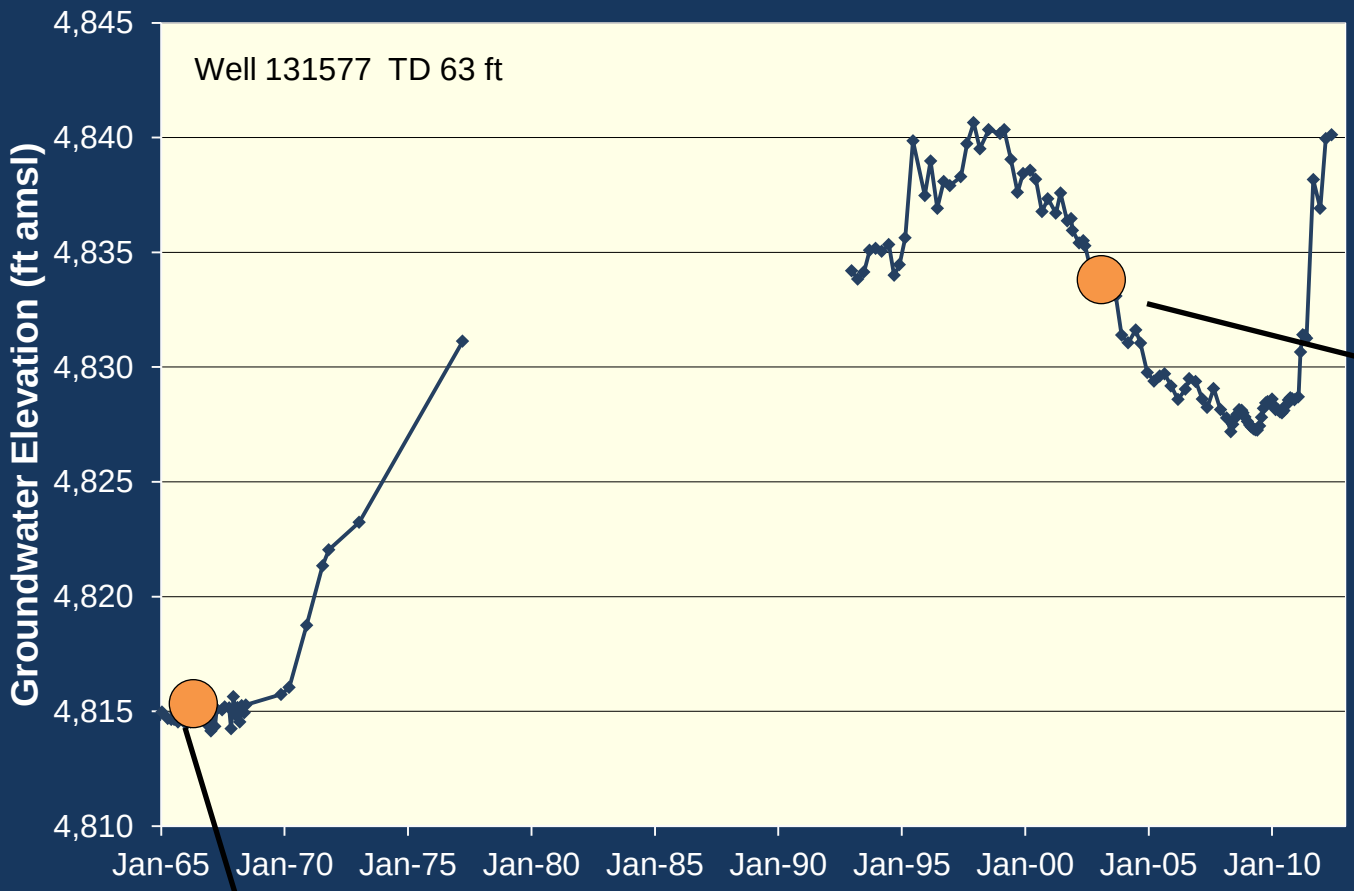
East Bench

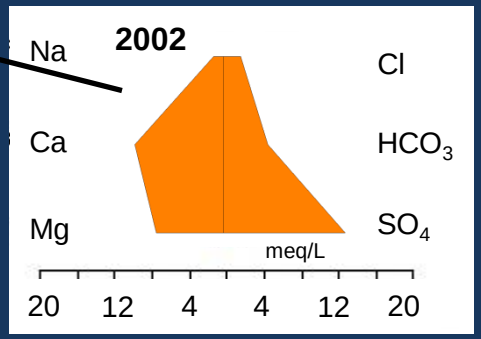


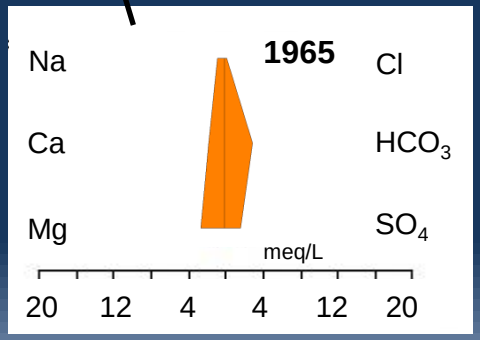


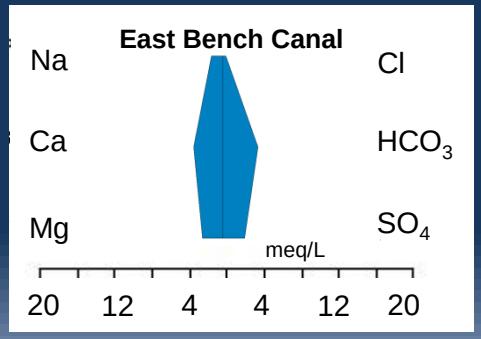


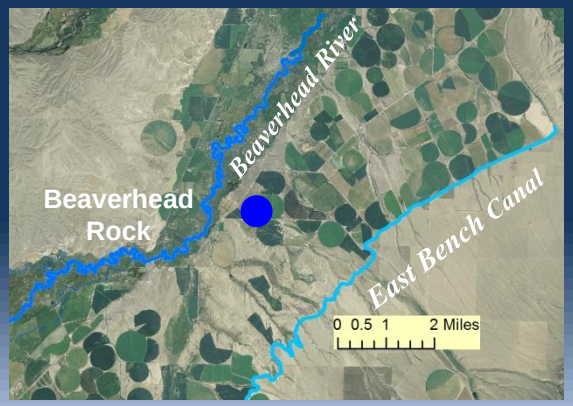
Departure from Annual Average Precipitation

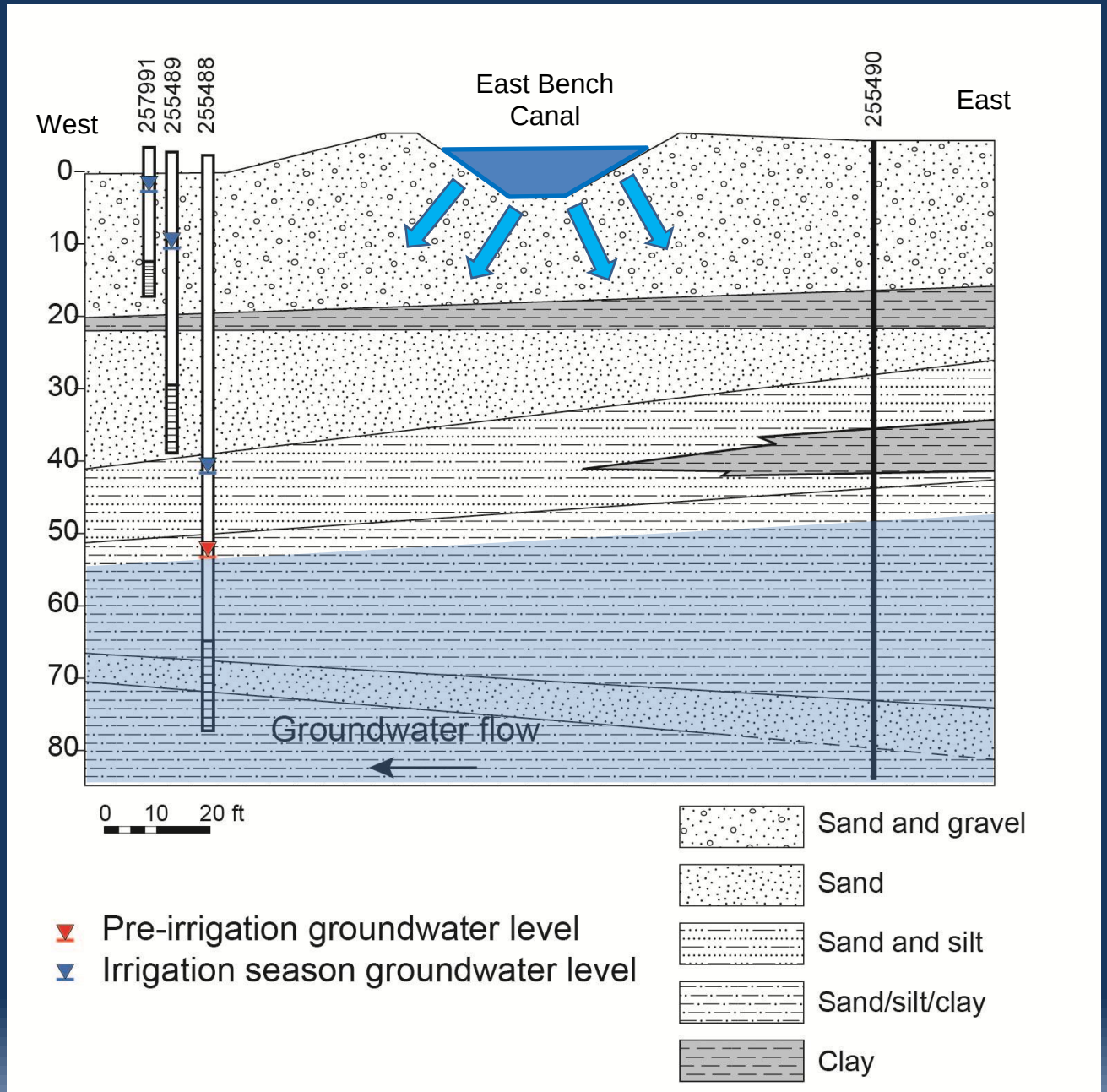

Well 131577 TD 63 ft
Groundwater Elevation (ft amsl)
4,845
4,840
4,835
4,830
4,825
4,820
4,815
4,810
Jan-65
Jan-70
Jan-75
Jan-80
Jan-85
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10

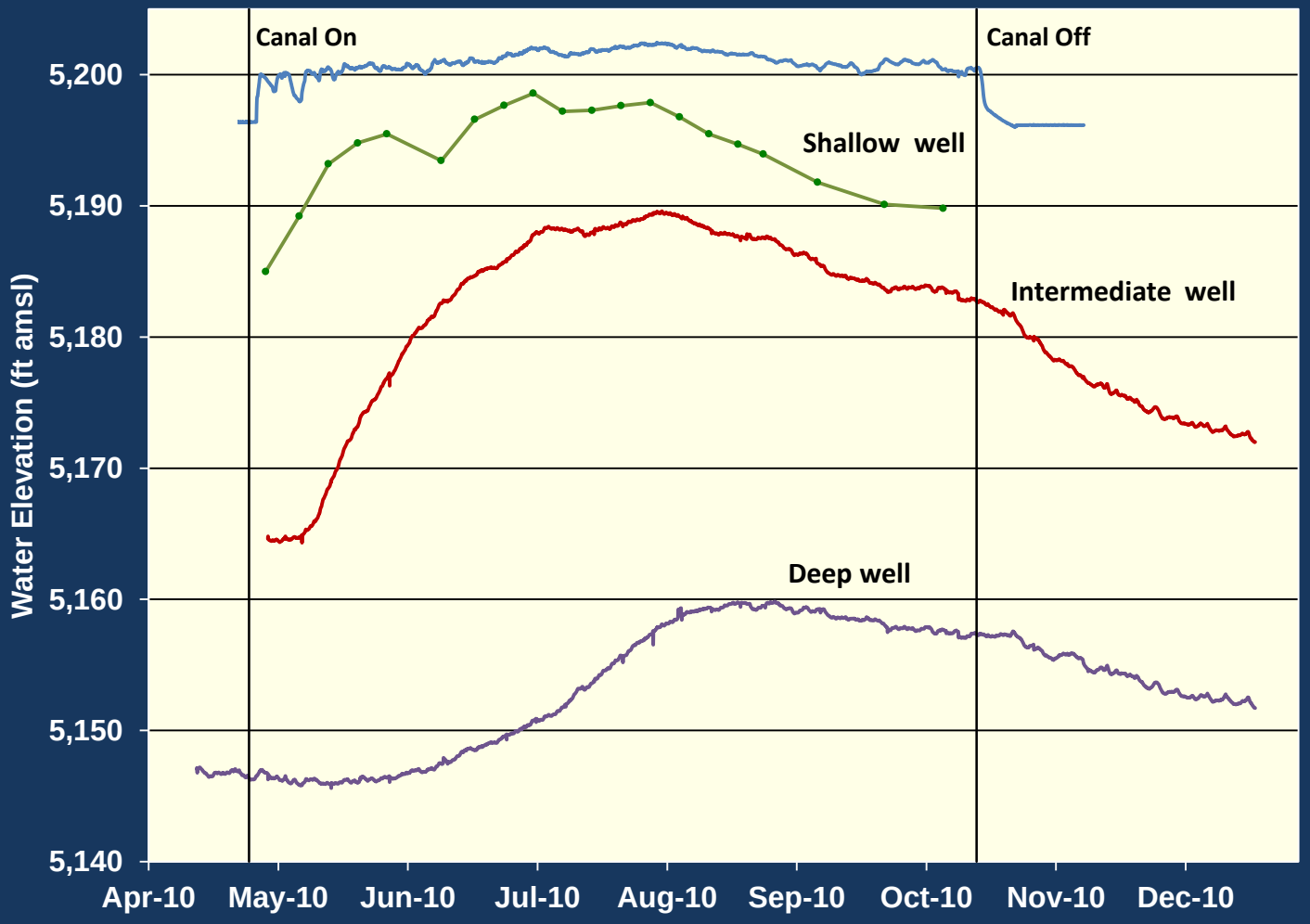

2002
Na
Cl
Ca
HCO_3
Mg
SO_4
meq/L
20 12 4 4 12 20

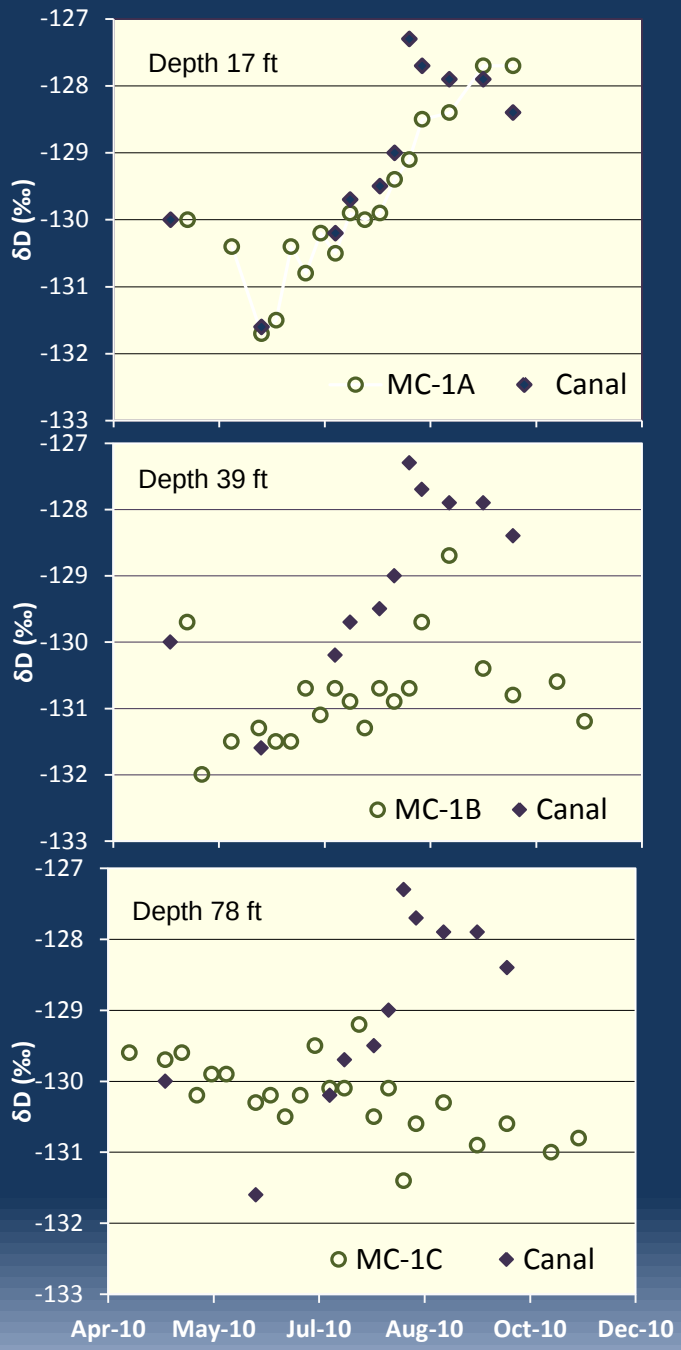

1965
Na
Cl
Ca
HCO_3
Mg
SO_4
meq/L
20 12 4 4 12 20


East Bench Canal
Na
Cl
Ca
HCO_3
Mg
SO_4
meq/L
20 12 4 4 12 20

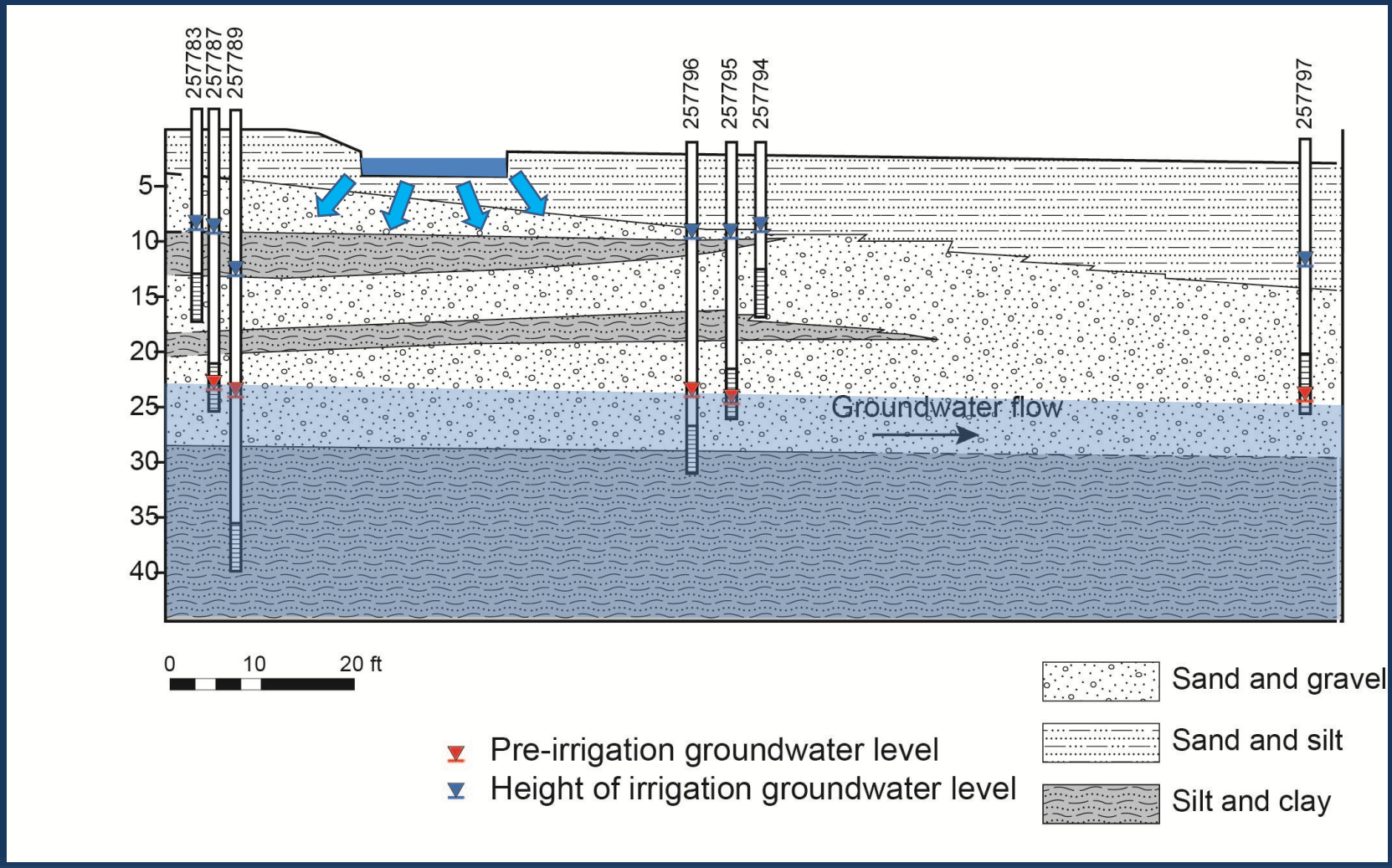

Beaverhead River
Beaverhead Rock
East Bench Canal
0 0.5 1 2 Miles

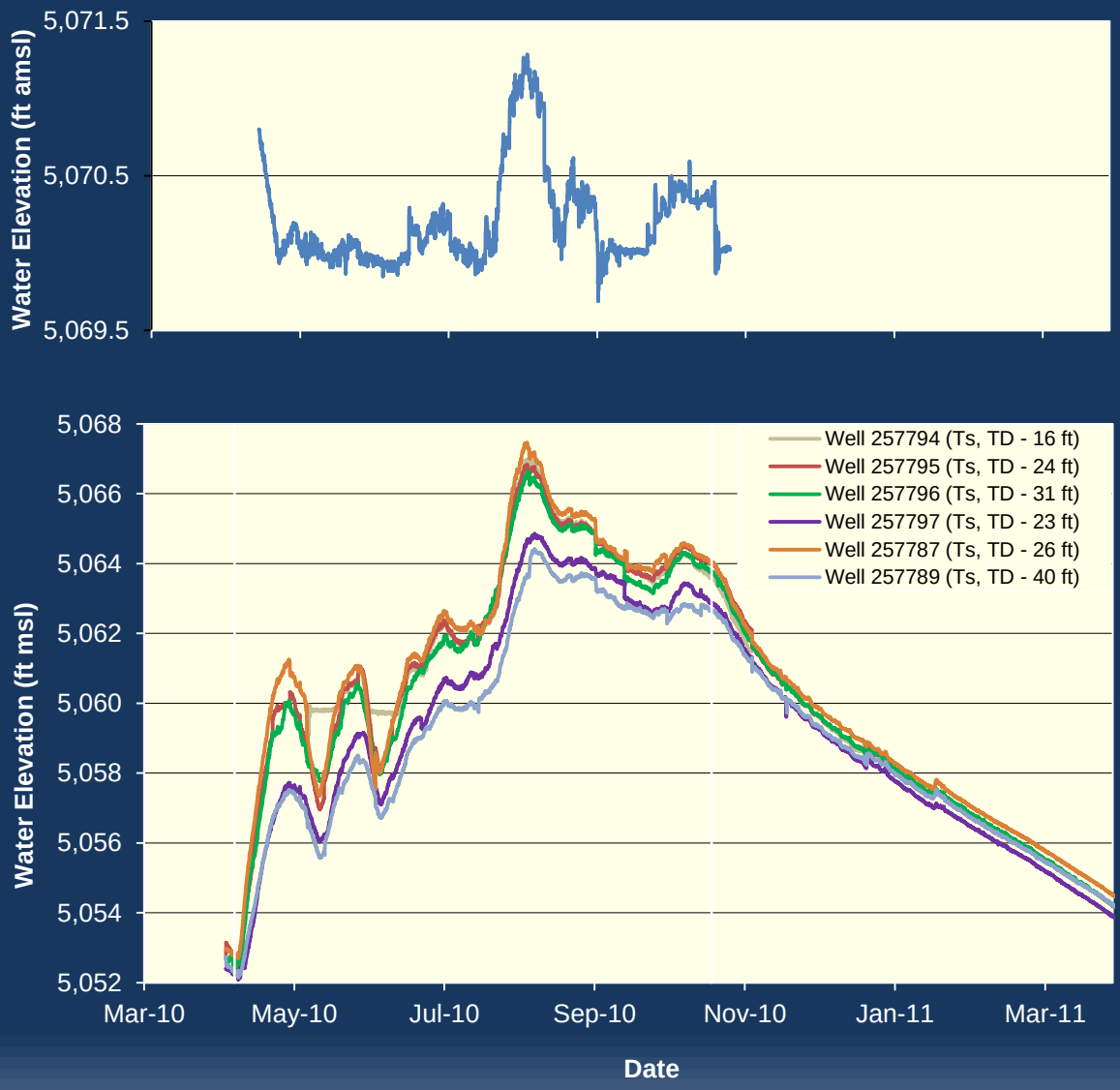

West
257991
255489
255488
East Bench
Canal
255490
East
0
10
20
30
40
50
60
70
80
Groundwater flow
0 10 20 ft
Pre-irrigation groundwater level
Irrigation season groundwater level
Sand and gravel
Sand
Sand and silt
Sand/silt/clay
Clay

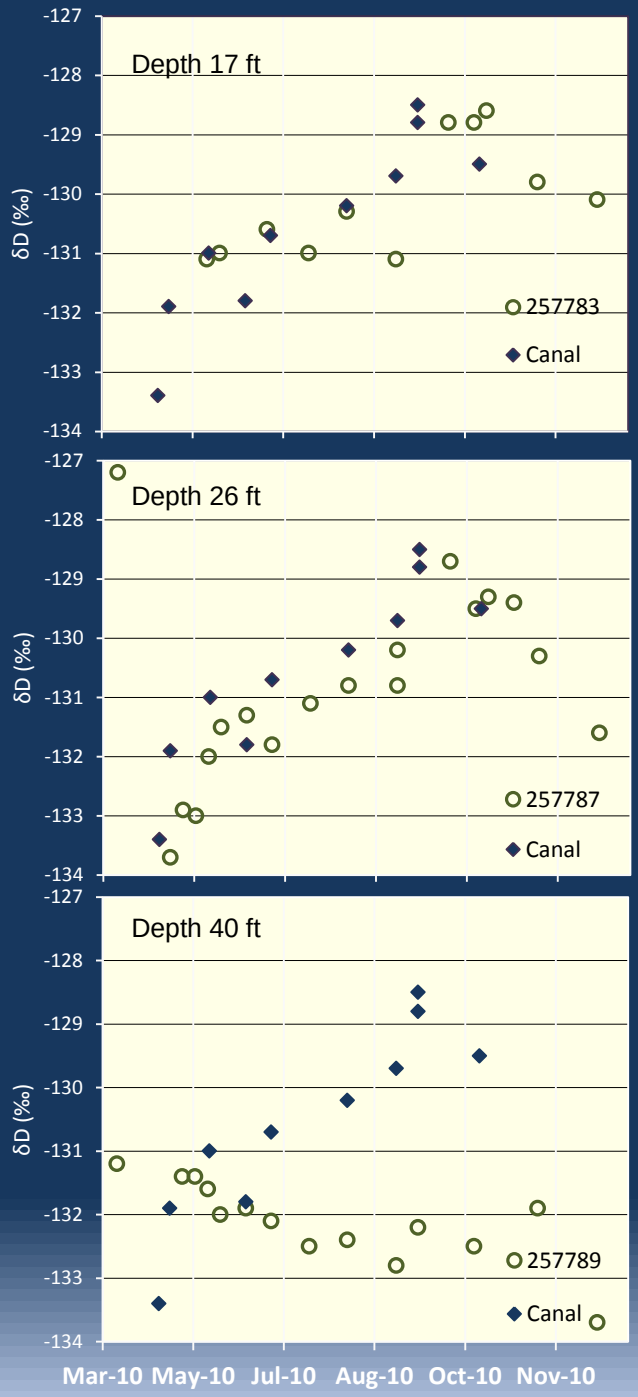

Canal On
Canal Off
Shallow well
Intermediate well
Deep well
Water Elevation (ft amsl)
5,200
5,190
5,180
5,170
5,160
5,150
5,140
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10


Depth 17 ft
δD (‰)
-127
-128
-129
-130
-131
-132
-133
MC-1A
Canal
Depth 39 ft
δD (‰)
-127
-128
-129
-130
-131
-132
-133
MC-1B
Canal
Depth 78 ft
δD (‰)
-127
-128
-129
-130
-131
-132
-133
MC-1C
Canal
Apr-10
May-10
Jul-10
Aug-10
Oct-10
Dec-10

West Side Canal

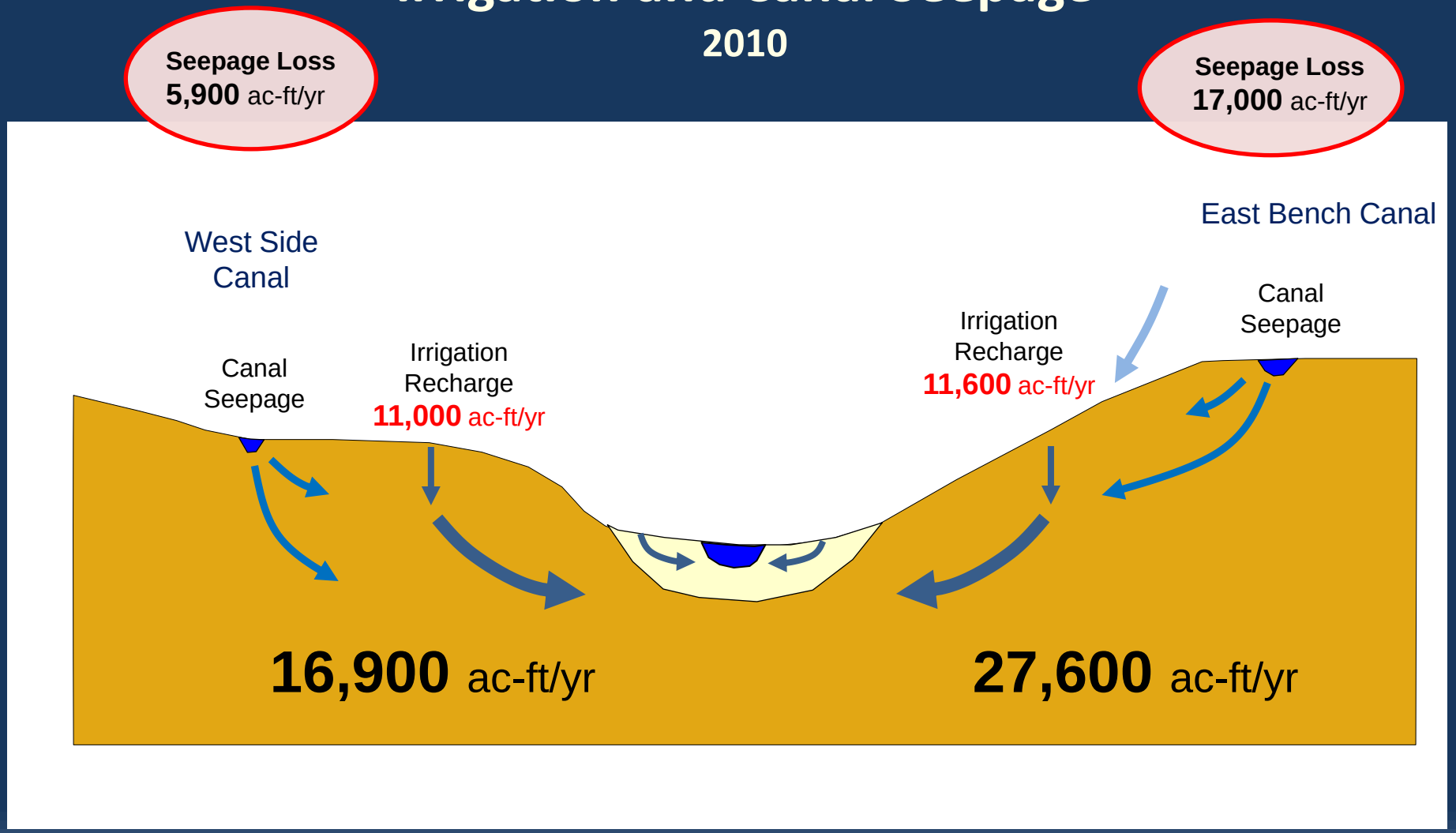



5,071.5
5,070.5
5,069.5
Water Elevation (ft amsl)
5,068
5,066
5,064
5,062
5,060
5,058
5,056
5,054
5,052
Water Elevation (ft msl)
Well 257794 (Ts, TD - 16 ft)
Well 257795 (Ts, TD - 24 ft)
Well 257796 (Ts, TD - 31 ft)
Well 257797 (Ts, TD - 23 ft)
Well 257787 (Ts, TD - 26 ft)
Well 257789 (Ts, TD - 40 ft)
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
Date


Depth 17 ft
δD (‰)
-127
-128
-129
-130
-131
-132
-133
-134
257783
Canal
Depth 26 ft
δD (‰)
257787
Canal
Depth 40 ft
δD (‰)
257789
Canal
Mar-10
May-10
Jul-10
Aug-10
Oct-10
Nov-10

Groundwater Recharge from Irrigation and Canal Seepage

2010

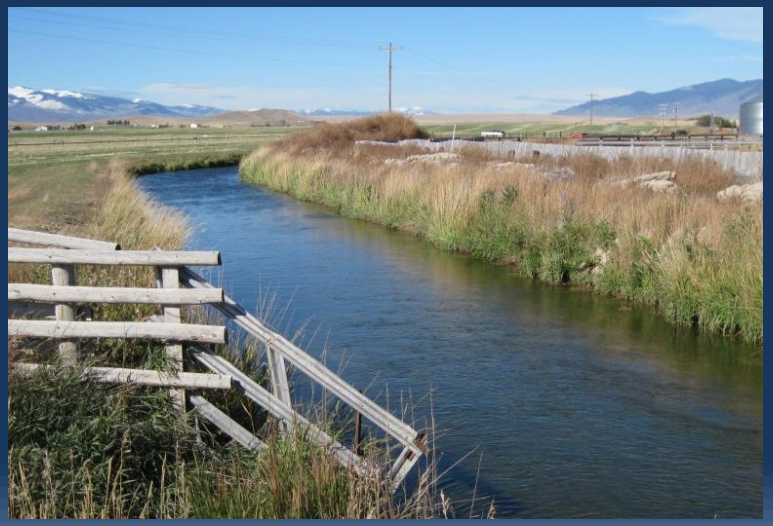


Average Canal Seepage Loses across Montana

• East Bench Canal	2.2 cfs/mile
• West Side Canal	1.2 cfs/mile
• Bozeman area ditches	1.1 cfs/mile
• Upper Big Hole	0.15-1.5 cfs/mile
• Helena Valley	0.6 cfs/mile
• Billings area	0.05-0.5 cfs/mile
• Stillwater-Rosebud Watershed	1.1-1.8 cfs/mile
• Greenfields Bench	0.45-4.7 cfs/mile

Factors influencing canal seepage

- Geologic material
- Depth to groundwater
- Irrigation season changes
- Wetted perimeter
- Maintenance



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